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JAPANESE SPONGE CULTURE EXPERIMENTS IN THE SOUTH PACIFIC ISLANDS

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Army

1. Purpose and Scope

For some years before World War II, scientific and research information from the South Pacific Islands under Japanese control was not available as these areas were closed to everyone except Japanese nationals. Since the surrender, work has been under way to collect and compile records of all available scientific investigations in those areas during the years of Japanese domination, and to make those records readily accessible for use in the administration of Japan and of the Pacific islands.

Following investigations in the South Pacific areas after the cessation of hostilities of World War II, Mr. Robert O. Smith published Fishery Resources in Micronesia, 1/ including therein a brief summary of his observations on sponge culture (pp 36-37). The object of this preliminary study is to answer some of the questions raised in Smith's report and to supply additional information which has been obtained on the Japanese experiments.

2. Sources

As Smith's observations form the starting point for this study, they are quoted in full:

> "Sponges: Native sponges of several unidentified species, especially of the horny (Class Demospongiae) varieties, are common throughout the ex-mandate. At Ponape, Kusae and Likiep, they are abundant enough to be used in place of a towel after bathing, and for scouring cooking utensils. They occur in depths less than two fathoms but no investigation was possible to determine if there were additional resources at greater depths. The specimens seen had no commercial value, and the Japanese did not attempt to harvest them.
>
> "Japanese Sponge Culture in the Marshalls. In June and July of both 1939 and 1940, the Japanese imported live sponges to Ailinglapalap Atoll and planted them in a protected area of about 2 acres with a depth of 3 to 5 fathoms over a fine white coral sand bottom. In the absence of any Japanese records regarding this project, there is no way of determining where the sponges were brought from, how they were kept alive in transit, how many were planted, or how large each cutting was. The information presented here is from an inspection of the plantings on August 26, 1946, and conferences with natives nearby.
>
> "The method of planting was simple, and carried out by natives under Japanese supervision. Cement blocks 5 x 5 x 2 inches were used as anchors; from this block a piece of solid aluminum wire, about No. 12, stretched upward to a float made of a tightly corked and sealed Japanese beer bottle. The length of wire varied somewhat, but was long enough so that 24 sponge cuttings could be strung on it about 4 inches apart. A few wires had as many as 30 sponges on them. Not all of the cuttings survived, but mortality was not excessive for almost all wires had 20 to 24 sponges on them. The bottle float was from 1 1/2 to 2 fathoms below the surface. The lowest sponge was 12 to 18 inches above the bottom. Anchors were spaced 10 feet apart on the bottom, sufficient to prevent fouling the wires in case of a storm, for we saw no wires which had become tangled.

1/ Smith, Robert O., Fishery Resources of Micronesia: Fish and Wildlife Service Fishery Leaflet 239, pp 1-46, May 1947

"According to a native informant, samples were sent to Japan, but no commercial harvest was made. A few sponges were taken by the natives for washing babies. Their method of cleaning sponges is to bury them under water and sand on the lagoon reef for 3 days, wash in salt water followed by fresh (rain) water, then dried in the sun.

"Although it was impossible to make an exact count, there are several hundred sponges remaining. The aluminum wire is becoming brittle, and the sponges should be restrung or removed by August, 1947.

"The sponges are a very dark blue color when alive, but after cleaning are very nearly white without bleaching. The size varied from 4 to 6 1/2 inches in largest dimension. Shape was rather irregular, almost all individuals having one or more short protuberances which prevented them from having a spherical shape.

"Dr. M. W. de Laubenfels reported on a sponge sent him for identification as follows: 'The specimen is Spongia officinalis, subspecies mollissima, known as Fine Levant or Turkey Solid. One expects to find this exclusively in the eastern Mediterranean, and it is absent or rare elsewhere in the world. The specimen is one of the finest I have ever seen. Its fibers are a little bit weak, perhaps as a result of chemical bleaching, but in general it is worthy of enthusiasm. This is the sort of sponge that is suitable for some of the highest-price use, such as for blood absorption in surgical operations. I have tested it carefully; its elasticity, holding power, and all-round "sponginess" are superlative'."

Additional information bearing on the questions raised by Smith has been obtained from Mr. Kiyoshi Okajima, ex-chief of the Fisheries Division of the Mandated Islands, who supplied information concerning the Ponape, Palau, and Truk experiments; and Mr. Kiichi Kozuka, formerly in charge of sponge operations in the Marshall Islands, who supplied the information concerning Ailinglapalap and Namoric atolls. None of this information has previously been published.

SPECIES OF SPONGES

Knowledge of the species of sponges is basic to any discussion of sponge propagation. Unfortunately little scientific information is available on this subject from the South Pacific Islands, and it has not been practical to obtain material from the various localities in order to made scientific determinations for use in this study. As indicated, Dr. de Laubenfels determined the specimens submitted by Smith as Spongia officinalis mollissima. The author of this study submitted specimens of the cultivated Ailinglapalap sponge to the United States National Museum for identification. The Museum sent the specimens to Dr. de Laubenfels in Honolulu who identified them as belonging to the species Spongia officinalis Linne. Although they are close to the variety mollissima, he thinks that a new variety or subspecies should be erected for them. He considers them to be the West Pacific equivalent of the fine Turkish sponge.

CAROLINE ISLANDS EXPERIMENTS

1. Ponape

The sponge culture experiments by the Japanese in the Caroline Islands were started at Ponape in 1927, under the over-all supervision of Mr. K. Okajima. These experiments were the first of a series in the ex-mandated area which culminated in successful cultivation at Ailinglapalap Atoll in the Marshall Islands. Considerable difficulty was encountered at the start because of lack of practical experience in the transportation and culture of sponges and because of unsatisfactory local environment. The water around Ponape was turbid, the reef steep, and the ocean currents sluggish. All of these factors later were found to be unfavorable to sponge culture. That this was true was further indicated by the absence of native sponges in the vicinity.

About 90 miles from Ponape is the island of Nachic, where the Japanese on previous visits had discovered two species of native sponges growing abundantly on sticks and rocks inside the atoll in water one to two meters deep. These sponges, which were known locally as the sheep-wool and the velvet, were the source of material for the Ponape sponge culture experiments.

Fifty small, ball-shaped lumps of the velvet sponge, about three inches in diameter, were collected and placed in a metal drum on the deck of a marine research vessel (10 tons, 30 horsepower). This drum was filled with sea water which was changed by pump every hour. However, during a 15-hour trip from Nachic to Ponape the water turned a milky-white color, and examination showed the sponges to be dead. A single poor change had left the water dirty, and the sponges had suffocated. The experiment was not a total loss, however, because, while gathering sponges at Nachic, the Japanese found that about 100 sponges which they had planted on a previous inspection trip had made successful growth attached to a concrete disc. This suggested the idea for the second step in transplantation experiments.

2. Truk

Although few high-quality sponges grew in the barrier reef around Truk, their presence at least indicated that the environment was suitable for sponge growth. The many excellent sponges which were found in the atoll of Kimjima were the source of material for the Truk experiments. The equipment used in these experiments consisted of round concrete plates 30 centimeters in diameter and five centimeters thick (Figure 1), No. 24 aluminum wire, and a sharp knife.

A suitable mother sponge was selected and cut from its attachment with a very sharp knife. This work was done under water. The mother sponge was then cut (still under water) into lumps six centimeters square. These were attached to the concrete discs by thrusting aluminum wire through the center of a sponge cube both ends of the wire being bent to hold the sponge firmly in place (Figure 1). This attachment completed, the discs were placed between suitable reefs at a depth of three to five meters.

The first series of discs was planted directly on a sandy bottom at intervals of one meter. However, the mortality rate was more than 50 percent, owing (1) to the penetration of sand into the sponges before firm adherence was possible; (2) to the sinking of the discs into the sand, suffocating the sponges; and (3) to the activities of enemies and parasites able to reach the sponges because of their proximity to the sea bottom. The next series of discs was raised above the bottom, and fair success was obtained.

The Kimjima sponges used were transported in the hold of the research vessel in water constantly being changed by pump action. Much larger lumps of sponge, weighing 10-20 kilograms including the contained water, were used, and the sponges were covered lightly with a fish net during transportation to prevent movement. These larger lumps proved best for a long voyage because they were stronger and had greater vitality than the smaller ones. This method of transportation and planting proved satisfactory, producing considerably more than 50 percent survival, but further experiments were determined upon.

3. Palau

Small-scale research on sponge culture was started at Palau in 1930 and was conducted until 1935, when intensive research was begun, starting at the point reached by the Ponape-Truk experiments. Fine-quality sponges were more abundant in the reefs at Palau than in any of the nearby atolls, and these were used as source material. Two lines of investigation were followed, the "set" method and the "hanging" method.

The set method was a modification of the concrete disc experiments. Frames or loops of No. 8 aluminum were set in concrete blocks, several sizes being used (Figure 2). The mother sponge was cut into four-centimeter cubes; one to four of these cubes were placed in each line group of sponges and suspended from the wires.

The discovery was made that a portion of the black surface of the mother sponge, previously thought to be indispensable on at least one face of the cut cube, was actually not essential to survival of the segment.

The hanging (or raft) method was something new. Materials required were bamboo shafts 10 centimeters in diameter and five meters in length, rope of hemp palm or coconut palm instead of aluminum wire, and a penetrating needle for stringing the sponges.

A raft was made of bamboo stocks crossing each other at 50 centimeter intervals. At each intersection a line group of sponges was suspended (Figure 3). This line was made by stringing the sponge cuttings on a slender coconut palm rope with the penetrating needle. Each line was two meters long and held about 10 sponges. A sinker weighing about 0.3 pound was placed at the end of each line to prevent sidewise motion, possible entanglement, and resulting injury to the cuttings. In floating the raft, the depth of the water did not have to be considered beyond insuring a depth greater than the length of the lines. A depth of 5-10 meters produced the best results. In shallow water a modification of this method was sometimes used, wherein the raft was fixed in position by attachment to bamboo posts driven into the ground (see Figure 3). Because of the resulting resistance to environmental conditions such as tide and wind action, this fixed method proved less satisfactory than the floating raft method.

The raft was usually fastened within a curved bay about 100 meters from the beach so that the wind could not blow directly on it. Special care was taken to place the raft where there was no influence from incoming fresh water. At the place selected the difference between ebb and flow at flood tide was two meters, the current 0.5 knots. The water was transparent and abounded in the plankton organisms considered necessary for the success of the planting.

At Palau the results of the hanging method proved superior to those of the set method. Although actual mathematical data have been lost, the growth reportedly was satisfactory, and the complete, spherical sponge resulting from this method was good. Life or death of the cutting was apparent within a week after hanging. One month after hanging, the sponges had begun to shape themselves and were becoming smooth and rounded at the corners; after three months they were nearly spherical. One year after hanging they had developed into a mass seven centimeters in diameter, and after 18 months to two years, even under the poorest conditions, they were as large as a fist. By this time thay had commercial value. During this two-year period the raft had to be repaired and the ropes replaced.

Some of the sponges died, but this hanging method was found to be incomparably better than the set disc methods. However, the Japanese believe that the water temperature, which remains about 27-30°C. throughout the year, results in sponges with less flexibility and larger breathing holes than those produced in either Florida or the Mediterranean Sea.

MARSHALL ISLANDS EXPERIMENTS

1. Ailinglapalap

Two of the questions raised by Smith involve the origin of the Ailinglapalap sponges and their method of transportation to that atoll. In answer to these questions, Mr. Kozuka emphasized that no sponges were introduced into Ailinglapalap, the sponges used there for artificial cultivation being local in origin or from nearby atolls. All the Japanese did was to apply artificial methods of propagation to local sponge species. No Mediterranean species were transported to Ailinglapalap.

The sponge culture experiments at Ailinglapalap Atoll began in June 1940 and ended in October 1943. The four experimental methods used there were:

a. Adhesion to concrete plate (ordinary disc method)

b. Shallow water culture (Japanese Govt. Patent No. 192,909)

c. Deep water culture (Japanese Govt. Patent No. 152,908)

d. Floating bottle method (Japanese Govt. Patent No. 153,504)

These four methods are briefly described:

a. The adhesion to concrete plate method was a repetition of the concrete disc method employed at Ponape, which has already been discussed.

b. In the shallow water method a series of vertical rafts arranged in groups of either three (triangular) or four (cubical) was anchored securely at one end in shallow water, the length (height) of the raft determining the depth of water required (Figure 4). This raft method was very satisfactory if used where the wind did not strike the raft directly.

c. The deep water method was a simplification of the shallow water method adapted to more rigorous conditions of wind, current, and tide. A single, vertically floating raft was anchored by a rope to a heavy concrete block, thus permitting movement of the raft (Figure 5). A large raft proved best for the production of sponges, because of its greater resistance to physical factors.

d. In the floating bottle method (Figure 6) an empty Japanese beer bottle, securely sealed, as described by Smith, was used as a float to suspend a series of four to five aluminum wire segments joined together. As many as 12 wire segments sometimes were linked if depth of water permitted. Each 60-millimeter segment was run through four or five sponge cubes, placed at four-inch intervals. The number of wire segments was determined by the local depth of water, and the lowest wire was attached to a concrete weight resting on the sea bottom. The bottle was floated about six inches below the surface at low tide. Use of a single long wire was eliminated after experimentation because of the difficulty in handling and the resultant injury to sponge cuttings.

Of the four methods, the floating bottle proved most satisfactory, producing most rapid growth with the highest percent of survival. Further advantages are that it is adaptable to water of any depth and requires a minimum of time and material.

Sheep-wool mother sponges were found available at Ailinglapalap Atoll, a yellow variety at Meditti Island, and a few at Mille and Meduro islands. In cutting the mother sponge, only a very sharp knife should be used. If the attachment of the mother sponge to the rock is left intact, the original sponge will regenerate and can be cut again in two to three years, thus maintaining an adequate supply of source material for a large number of cuttings.

After the sponges were transported to the planting area, it proved necessary to permit them to rest for two weeks to recover from the shock of the trip; then all dead portions were cut out. This resting period should be provided on a submerged floating raft, with care taken to insure that the sponges do not rub against each other.

The following technique was used in setting out the sponge cutting: The tip of the aluminum wire was filed to a very sharp point, and the wire was thoroughly cleaned to remove dirt and rough spots before it was run through the sponge cubes. The mother sponge was cut into cubes, which were then threaded onto the wire; the black surface from the mother sponge, if present on a cube, was placed uppermost. It is often said that sponges must not be handled in air if they are to survive, but the experience of the Japanese at Ailinglapalap showed that this is not true, if the exposure is brief and the direct rays of the sun are avoided.

After collecting, the culture sponges were cleaned by burial in the beach sand between tidal levels, where they were left from two to four days. "Refined" sponges were thus obtained, often within 48 hours under favorable hot weather conditions.

If the sea bottom were cleared of debris in this very limited area at Ailinglapalap, about 2,000,000 sponges probably could be raised there annually. The area could be worked successfully from July to October. During the rest of the year the wind and wave conditions handicap operations, and sustained work proved impractical.

2. Namoric

Namoric Island is a small atoll in the Ralick chain of the Marshalls. The Japanese believe that the physical, chemical, and oceanographic conditions of this atoll afford the best natural area for sponge culture known to them in the entire ex-mandated area. Although the atoll is small, it contains many places where sponges can be cultured successfully, where neither wind nor wave action can strike the cultures. Although no experimental work has been done at Namoric, the Japanese believe that this little atoll could produce 18,000,000 sponges annually.

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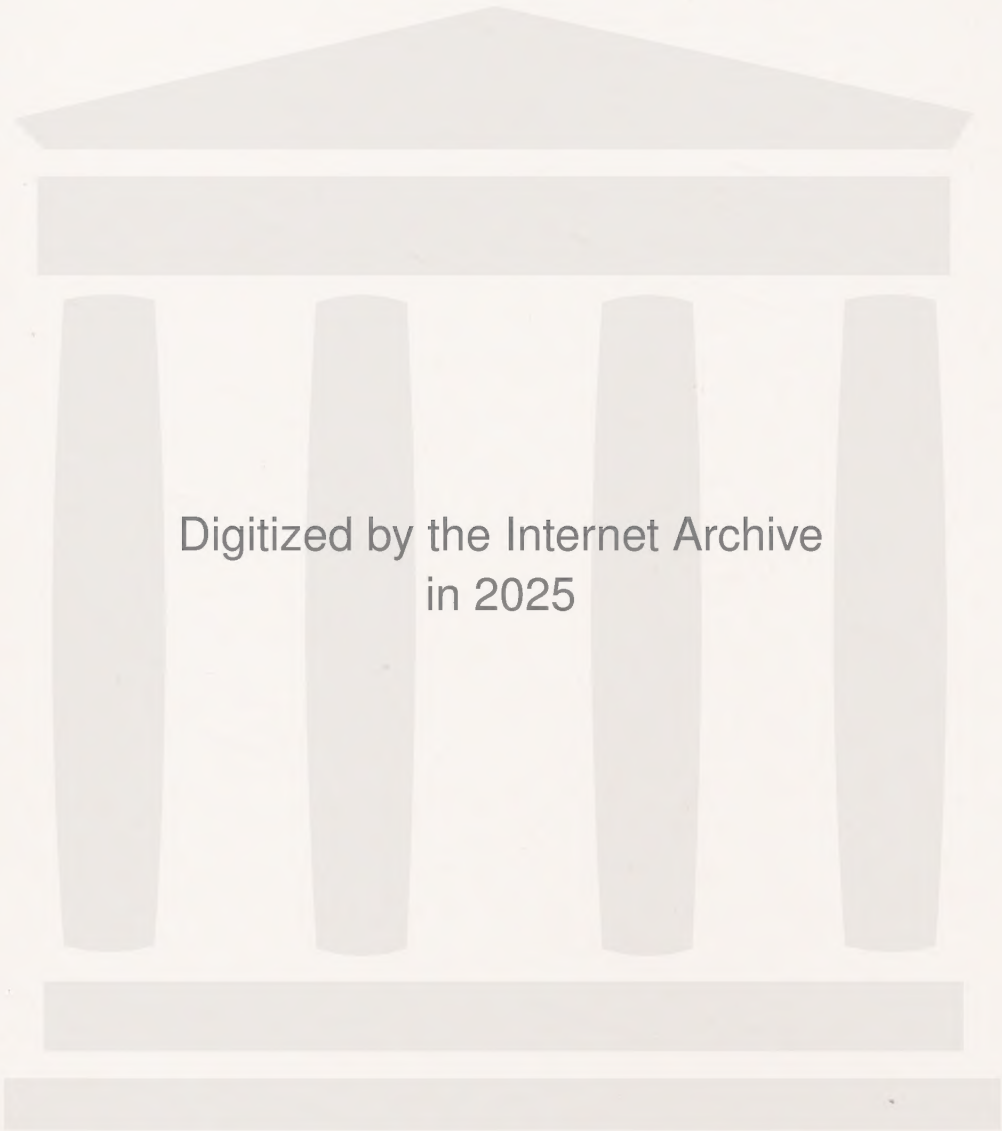

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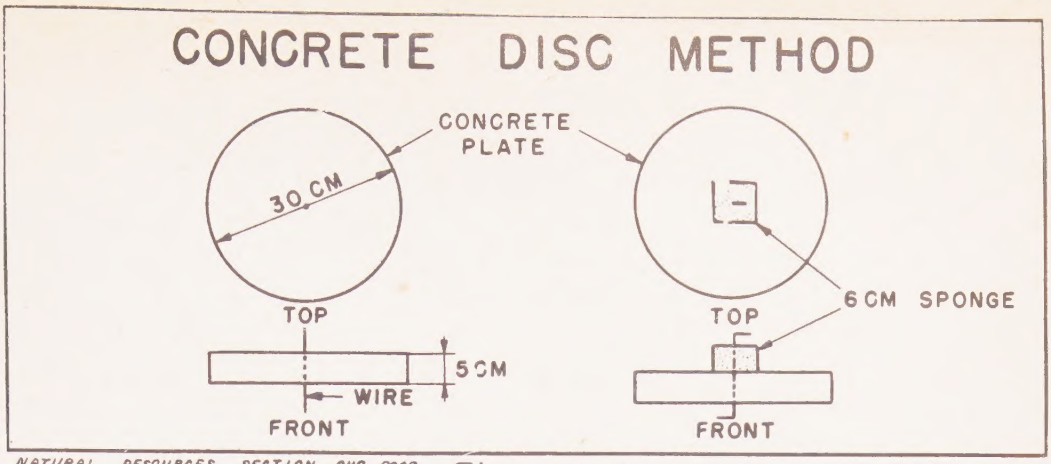
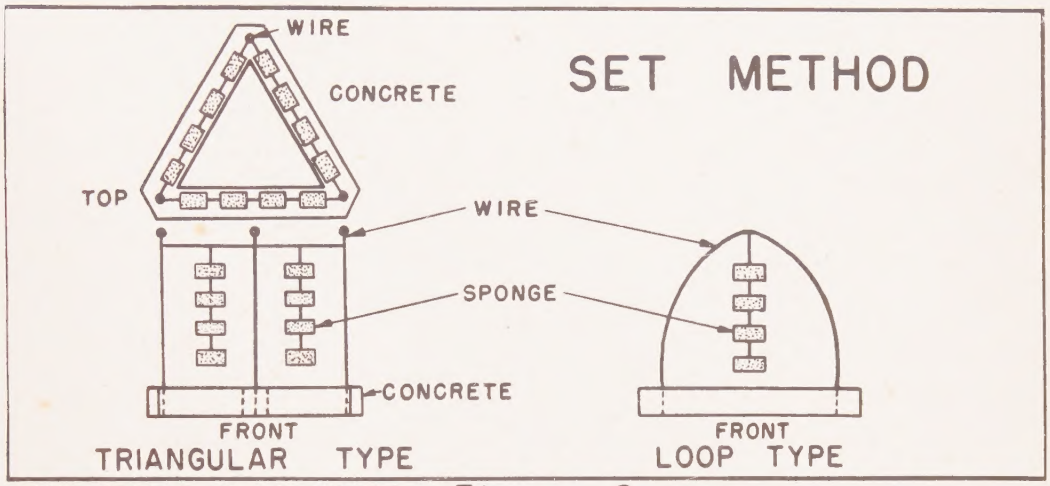


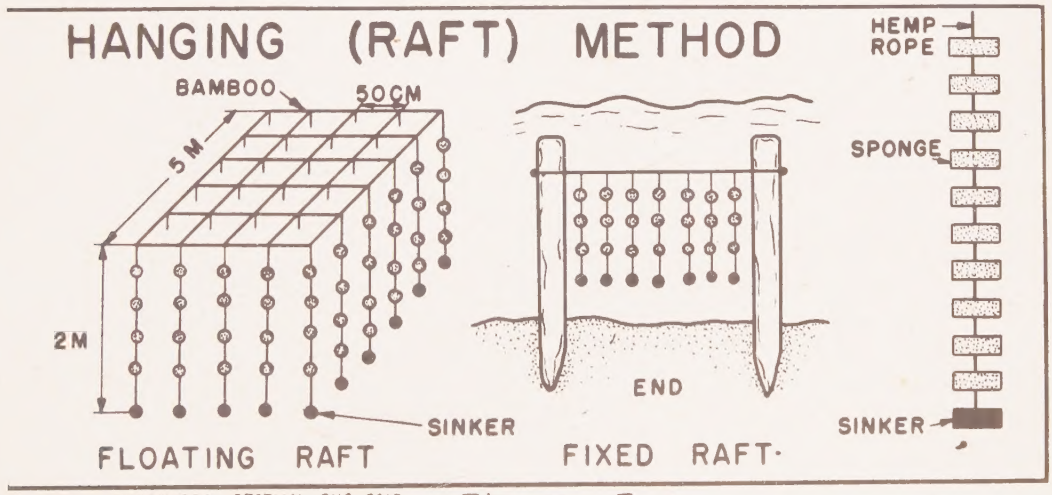
NATURAL RESOURCES SECTION CHQ SCAP

Figure 1



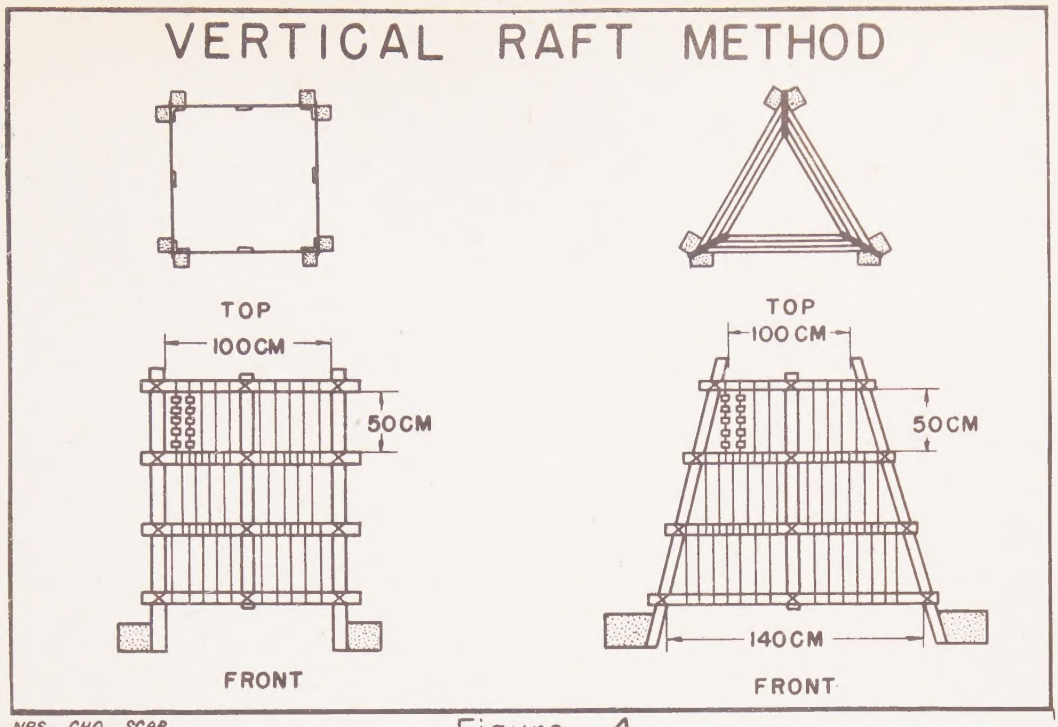
NATURAL RESOURCES SECTION CHQ SCAP

Figure 2

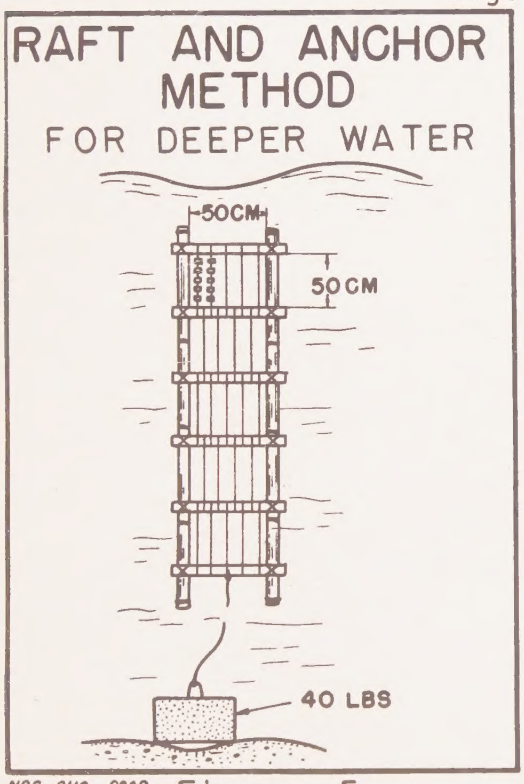


NATURAL RESOURCES SECTION CHQ SCAP

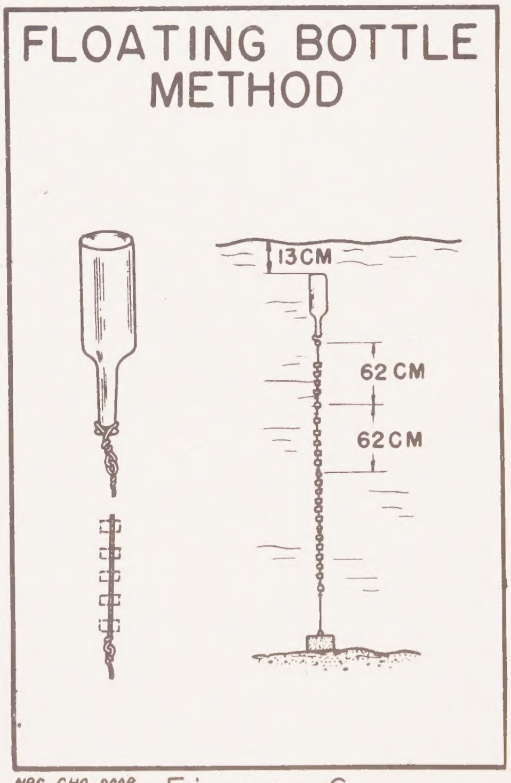
Figure 3



NAS CHQ SCAP Figure 4



NAS CHQ SCAP Figure 5



NAS CHQ SCAP Figure 6

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